US008315502B2

(12) **United States Patent**
Martch et al.

(10) **Patent No.: US 8,315,502 B2**
(45) **Date of Patent: Nov. 20, 2012**

(54) **SYSTEMS AND METHODS FOR SELECTIVE ARCHIVAL OF MEDIA CONTENT**

(75) Inventors: **Henry Gregg Martch**, Parker, CO (US); **William Michael Beals**, Englewood, CO (US)

(73) Assignee: **EchoStar Technologies L.L.C.**, Englewood, CO (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 388 days.

(21) Appl. No.: **12/632,942**

(22) Filed: **Dec. 8, 2009**

(65) **Prior Publication Data**

US 2011/0135284 A1 Jun. 9, 2011

(51) **Int. Cl.**
H04N 5/932 (2006.01)

(52) **U.S. Cl.** **386/216**; 386/200

(58) **Field of Classification Search** ..... None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,765,164	A	6/1998	Prasad	
5,826,168	A	10/1998	Inoue et al.	
6,701,528	B1	3/2004	Arsenault et al.	
7,110,006	B2	9/2006	MacInnis et al.	
7,191,215	B2	3/2007	Ganesan	
7,627,888	B2	12/2009	Ganesan	
2001/0019630	A1	9/2001	Johnson	
2002/0154892	A1	10/2002	Hoshen et al.	
2003/0026254	A1	2/2003	Sim	
2004/0143672	A1	7/2004	Padmanabham et al.	
2006/0037037	A1	2/2006	Miranz	
2006/0085817	A1	4/2006	Kim	
2006/0206609	A1	9/2006	Ganesan et al.	
2006/0206889	A1	9/2006	Ganesan	
2006/0218217	A1	9/2006	Ganesan et al.	
2006/0218218	A1	9/2006	Ganesan et al.	
2006/0218220	A1	9/2006	Ganesan et al.	
2006/0248078	A1	11/2006	Gross et al.	
2007/0038687	A1 *	2/2007	Carroll et al.	707/204
2007/0056002	A1	3/2007	Ganesan et al.	
2007/0255913	A1	11/2007	Weaver	
2008/0022343	A1	1/2008	Hodzic et al.	
2008/0216120	A1 *	9/2008	Knudson et al.	725/40
2008/0243769	A1 *	10/2008	Arbour et al.	707/2

(Continued)

FOREIGN PATENT DOCUMENTS

EP	1431979	A1	6/2004

(Continued)

OTHER PUBLICATIONS

International Search Report and Written Opinion mailed on Mar. 31, 2011 for PCT/US2010/059013.

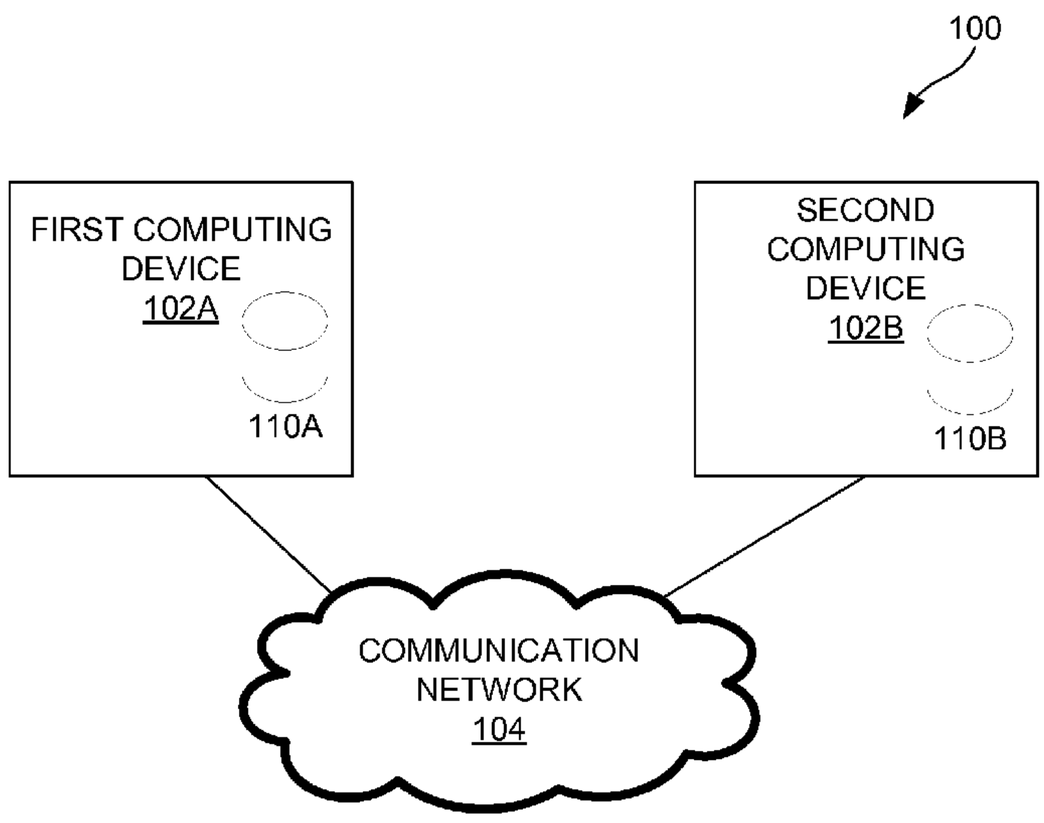
(Continued)

Primary Examiner — William C Vaughn, Jr.
Assistant Examiner — Eileen Adams
(74) *Attorney, Agent, or Firm* — Ingrassia Fisher & Lorenz, P.C.

(57) **ABSTRACT**

Described herein are techniques for selective archival of media content. A first entertainment device stores a plurality of media content files on a first storage medium. The first entertainment devices selects a portion of the media content files for backup based on characteristics of the media content files and transmits the portion of the media content files to a second entertainment device through a communication network. The second entertainment device stores the portion of the media content files on a second storage medium associated therewith.

17 Claims, 6 Drawing Sheets



U.S. PATENT DOCUMENTS

2008/0281913	A1	11/2008	Shankar et al.	
2008/0282036	A1	11/2008	Ganesan	
2009/0024762	A1	1/2009	Ganesan	
2009/0024846	A1	1/2009	Ganesan et al.	
2009/0025046	A1	1/2009	Ganesan et al.	
2009/0031424	A1	1/2009	Ganesan et al.	
2009/0106407	A1 *	4/2009	Kodama et al.	709/223
2009/0177712	A1	7/2009	Shimizu	
2010/0239226	A1 *	9/2010	Mountain	386/83
2010/0262997	A1 *	10/2010	Dove	725/44

FOREIGN PATENT DOCUMENTS

EP	1615133	A2	1/2006
WO	WO 2005/029852	A1	3/2005
WO	2009018428	A2	2/2009

OTHER PUBLICATIONS

U.S. Appl. No. 12/407,208, filed Mar. 19, 2008 in the name of Dale Mountain, 22 pages.

* cited by examiner

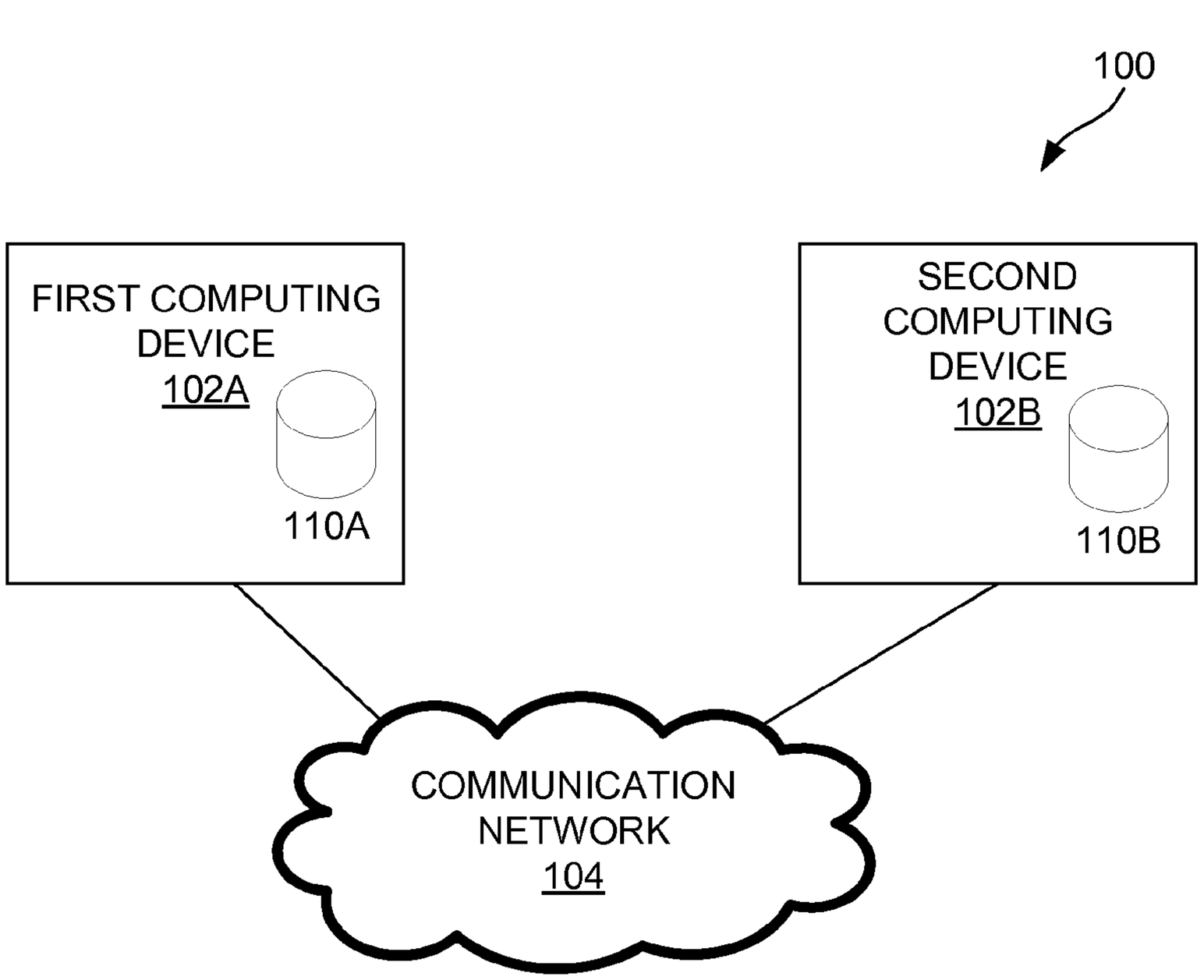

100
FIRST COMPUTING DEVICE
102A
110A
SECOND COMPUTING DEVICE
102B
110B
COMMUNICATION NETWORK
104

FIG. 1

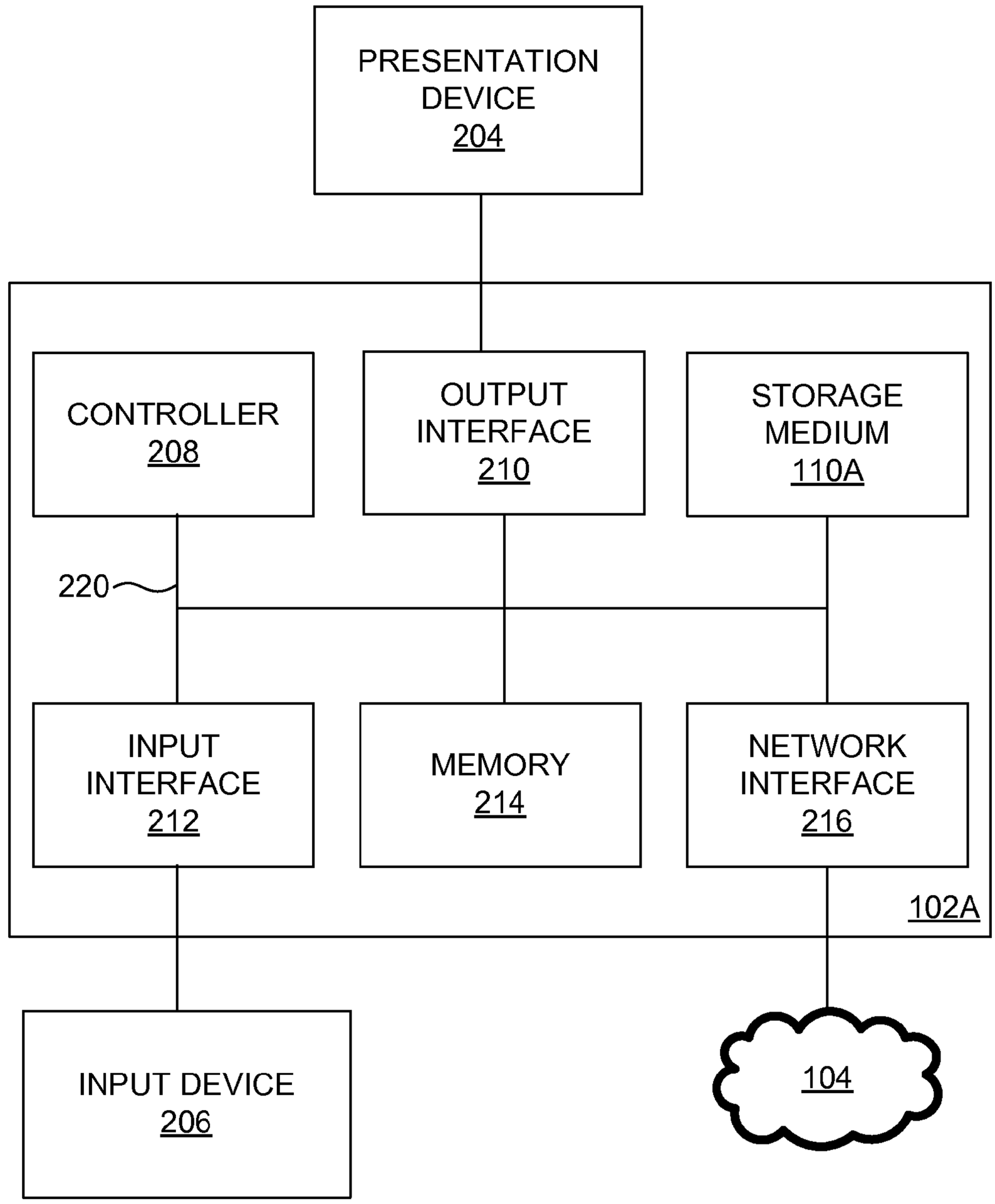

PRESENTATION DEVICE 204
CONTROLLER 208
OUTPUT INTERFACE 210
STORAGE MEDIUM 110A
220
INPUT INTERFACE 212
MEMORY 214
NETWORK INTERFACE 216
102A
INPUT DEVICE 206
104

FIG. 2

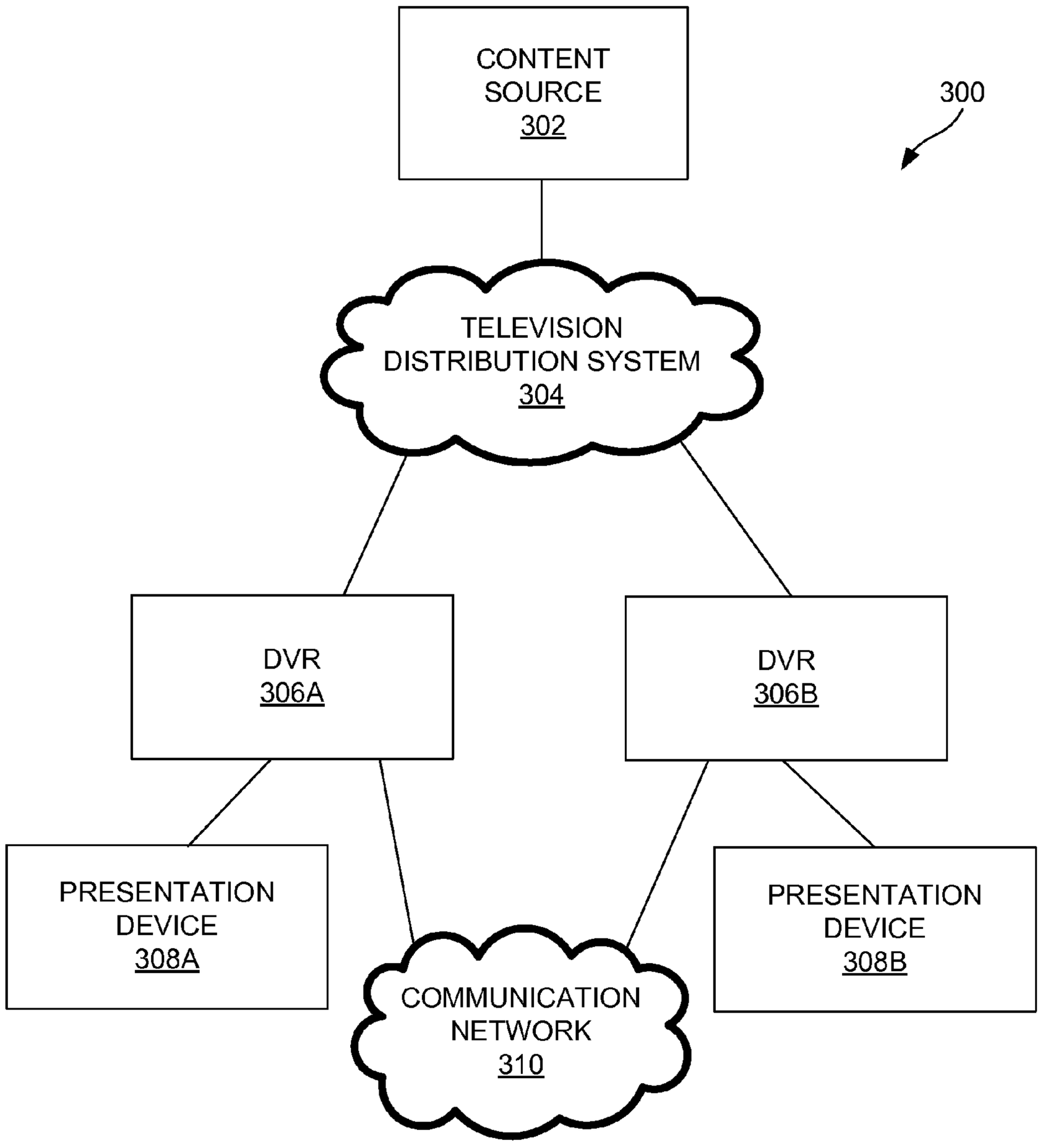

CONTENT SOURCE 302
300
TELEVISION DISTRIBUTION SYSTEM 304
DVR 306A
DVR 306B
PRESENTATION DEVICE 308A
PRESENTATION DEVICE 308B
COMMUNICATION NETWORK 310

FIG. 3

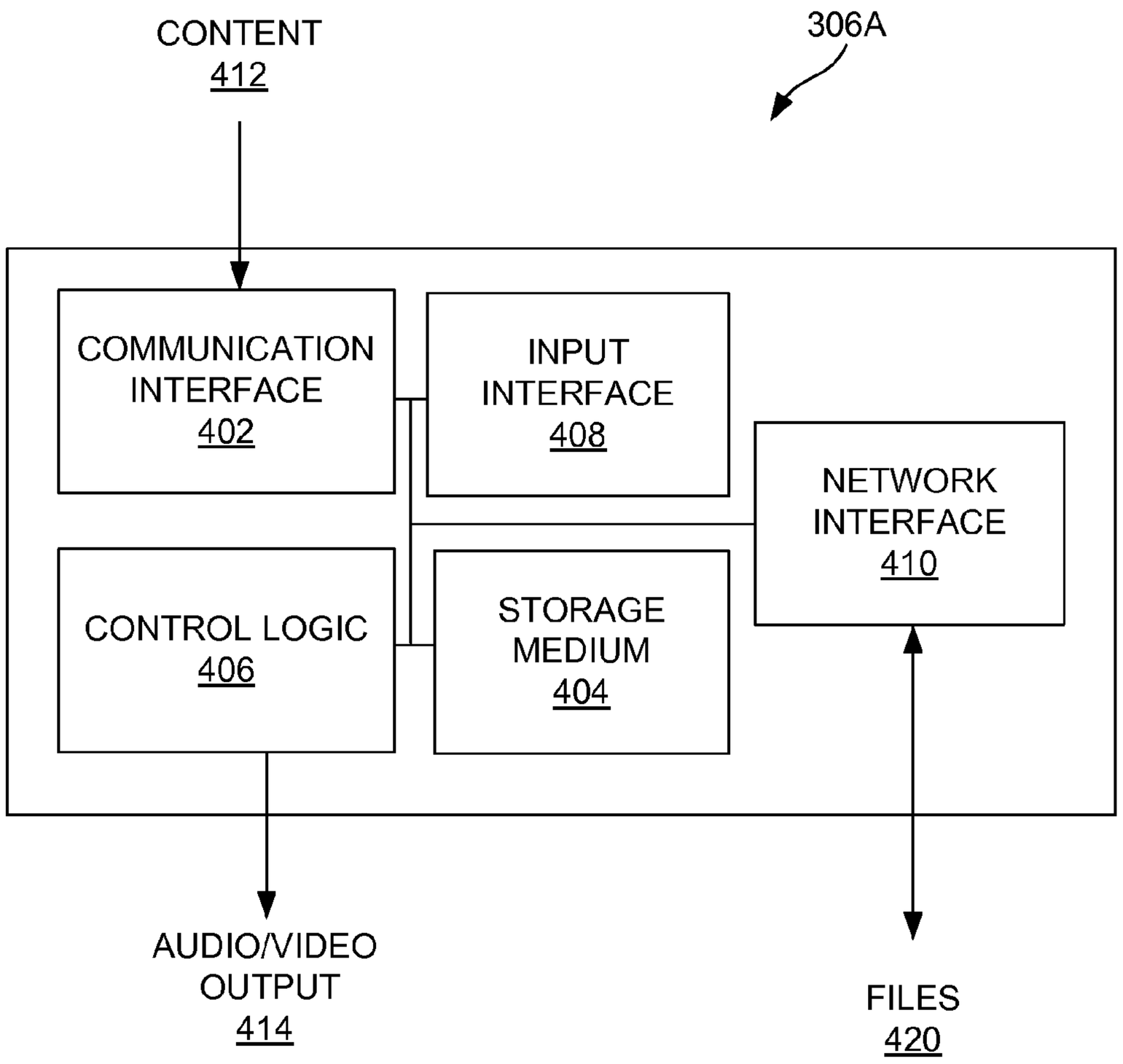

CONTENT
412
306A
COMMUNICATION INTERFACE
402
INPUT INTERFACE
408
NETWORK INTERFACE
410
CONTROL LOGIC
406
STORAGE MEDIUM
404
AUDIO/VIDEO OUTPUT
414
FILES
420

FIG. 4

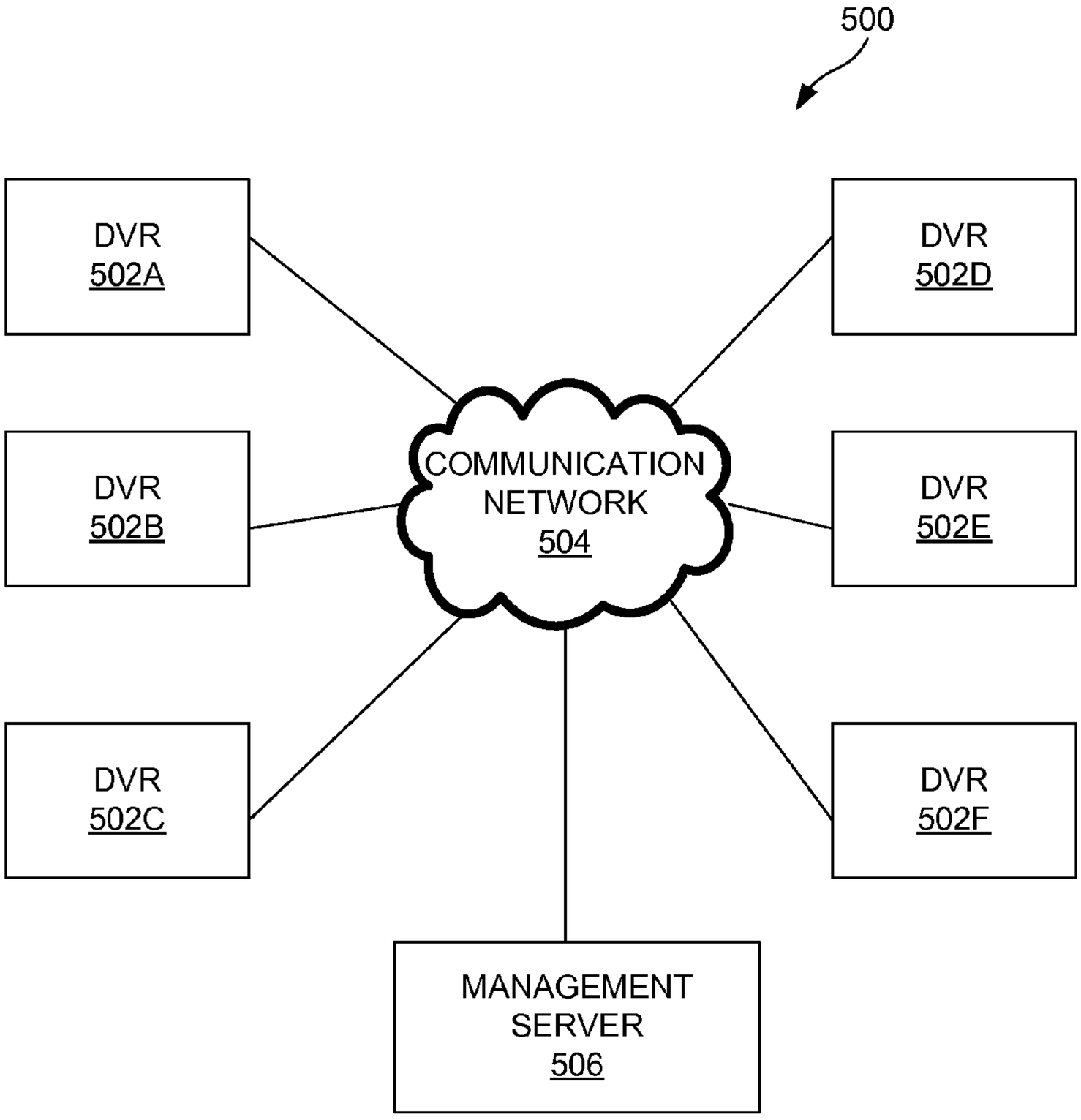

500
DVR
502A
DVR
502B
DVR
502C
DVR
502D
DVR
502E
DVR
502F
COMMUNICATION
NETWORK
504
MANAGEMENT
SERVER
506

FIG. 5

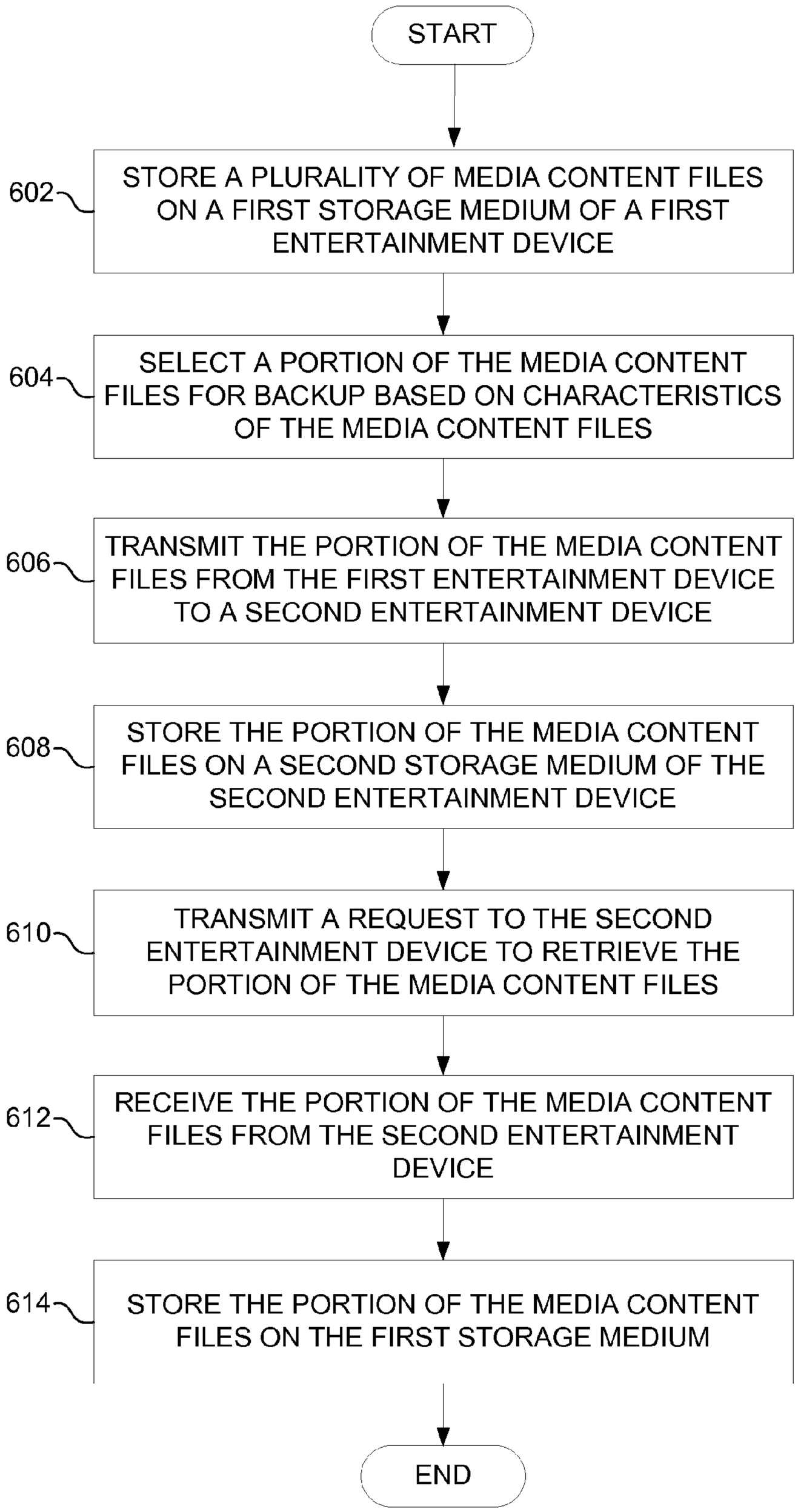

START
602
STORE A PLURALITY OF MEDIA CONTENT FILES ON A FIRST STORAGE MEDIUM OF A FIRST ENTERTAINMENT DEVICE
604
SELECT A PORTION OF THE MEDIA CONTENT FILES FOR BACKUP BASED ON CHARACTERISTICS OF THE MEDIA CONTENT FILES
606
TRANSMIT THE PORTION OF THE MEDIA CONTENT FILES FROM THE FIRST ENTERTAINMENT DEVICE TO A SECOND ENTERTAINMENT DEVICE
608
STORE THE PORTION OF THE MEDIA CONTENT FILES ON A SECOND STORAGE MEDIUM OF THE SECOND ENTERTAINMENT DEVICE
610
TRANSMIT A REQUEST TO THE SECOND ENTERTAINMENT DEVICE TO RETRIEVE THE PORTION OF THE MEDIA CONTENT FILES
612
RECEIVE THE PORTION OF THE MEDIA CONTENT FILES FROM THE SECOND ENTERTAINMENT DEVICE
614
STORE THE PORTION OF THE MEDIA CONTENT FILES ON THE FIRST STORAGE MEDIUM
END

FIG. 6

SYSTEMS AND METHODS FOR SELECTIVE ARCHIVAL OF MEDIA CONTENT

BACKGROUND

Digital video recorders allow users to store television programs, movies and other content for archival and subsequent viewing. The capacity of recording mediums of some digital video recorders (DVRs) allows for the storage of hundreds of hours of content which changes on a daily basis as users delete content and request recording of new content by the DVR. One problem with DVRs is that the associated recording mediums occasionally fail, causing a user to lose access to their recorded content. This is frustrating for the user, because it may take time to re-record the content during subsequent rebroadcasts of the content. It is even more frustrating for the user to lose some content which will be infrequently or never rebroadcast again.

BRIEF DESCRIPTION OF THE DRAWINGS

The same number represents the same element or same type of element in all drawings.

FIG. **1** illustrates an embodiment of a communication system.

FIG. **2** illustrates an embodiment of a computing device of FIG. **1**.

FIG. **3** illustrates another embodiment of a communication system.

FIG. **4** illustrates an embodiment of a DVR of FIG. **3**.

FIG. **5** illustrates another embodiment of a communication system.

FIG. **6** illustrates a process for storing media content.

DETAILED DESCRIPTION OF THE DRAWINGS

Described herein are systems, methods and apparatus for archiving data for backup and restoration. More particularly, described herein are systems, methods and apparatus for selecting portions of data stored on a first storage medium for selective backup on a second storage medium. Rather than backing up an entire storage medium for possible restoration later, portions of the data stored on the storage medium are selected for backup on another storage medium based on characteristics or attributes of the data. In short, described herein are systems, methods and apparatus for selective archival and backup of data.

Techniques are provided for selecting high value data on a storage medium for selective archival and backup on a second storage medium. In at least one embodiment, data may be assigned a value based on various characteristics of the data. For example, in various embodiments described herein, data may be assigned a high value for archival based on subject matter of the data, frequency of use of the data, user input and the like. Portions of data stored on a first storage medium are then selected based on the value and stored on a second storage medium. In at least one embodiment, the first storage medium may be associated with a first computing device and the second storage medium may be associated with a second computing device. The portion of data to be archived may then be transferred from the first computing device to the second computing device over an appropriate communication link, such as a communication network, USB, Firewire or the like and stored upon the second storage medium of the second computing device. If the first storage medium fails, then the data may be transferred from the second storage medium of the second computing device to the first computing device or a replacement device thereof and utilized to restore a portion of the first storage medium.

In at least one embodiment, the data stored on a storage medium comprises multimedia data, associated with a multimedia device, such as photos, video content, audio content, audio/video content or the like. Data may be selected for backup based on characteristics or attributes of the multimedia content, such as the subject matter of the multimedia content, frequency of use/viewing, metadata provided by a content provider or the like. Selected data may then be transferred from a first multimedia device to a second multimedia device and stored for backup purposes on a storage medium of the second multimedia device. In at least one embodiment, the selection and backup process may be transparent to the user. For example, backup data stored on the second multimedia device may be stored on storage locations that are not user accessible on the second multimedia device and the existence of the backup data stored thereupon may be transparent to a user of the second multimedia device. In other words, a user of the second multimedia device may not be aware that backup copies of data from the first multimedia device are stored on the second multimedia device.

Because complete duplication of data may not be appropriate in all circumstances, the techniques described herein strike a balance to provide backup of content which is most valued by the user. For example, two entertainment devices may have different capacity recording mediums and it may not be possible to backup all of the content from a larger recording medium onto a smaller capacity recording medium. Likewise, it may be inefficient to completely duplicate data stored on a storage medium, as the recording capacity for storing unique data or content on the two storage mediums is significantly diminished. This is especially true for storing data/content that is easily replaceable, such as content stored on a DVR that is frequently broadcasted. Thus, in the techniques described herein, data which is more difficult to replace and/or more valuable to a user is given a higher priority for backup, such that if a recording medium of an device fails, then the user can at least restore some of their higher valued data/content.

FIG. **1** illustrates an embodiment of a communication system **100**. The communication system **100** includes a first computing device **102**A, a second computing device **102**B and a communication network **104**. Each of the computing devices **102**A and **102**B includes at least one storage medium **110**A and **110**B, respectively. The communication system **100** may include other components, elements or devices not illustrated for the sake of brevity.

The first computing device **102**A may comprise any electronic device capable of processing and storing data on the storage medium **110**A. Examples of the first computing device **102**A include a desktop, laptop or tablet computer, mobile telephone or other wireless communication device, personal digital assistant (PDA), television receiver (e.g., cable, satellite, over-the-air or internet protocol television (IPTV)), DVR, MP3 player or other audio playback device, video game console, portable video player and the like. The first computing device **102**A processes, receives and/or generates data stored on the storage medium **110**A.

The storage medium **110**A may comprise any type of storage device, such as a magnetic hard drive, flash memory, optical storage, magnetic storage or the like. The data stored upon the storage medium **110**A may include any type of data received, utilized and/or generated by the first computing device **102**A. Examples of data stored on the storage medium

110A includes without limitation text files, databases, e-mails, software applications, photos, videos, audio files and the like.

In at least one embodiment, the second computing device 102B may be similar to the first computing device 102A and the second storage medium 110B may store similar data as the first storage medium 110A. For example, the first and second computing devices may both be computers that store various types of data, such as e-mails, word processing files, multimedia files and the like generated by one or more users. It is also to be appreciated that the first and second computing devices 102A and 102B may comprise different types of electronic devices that receive, generate and/or process disparate types of data. For example, the first computing device 102A may comprise a digital jukebox that stores audio files for playback and the second computing device 102B may comprise a DVR that receives and stores audio/video content (e.g., television programs) for playback by a user.

The first and second computing devices 102A and 102B are communicatively coupled through the communication network 104. The communication network 104 may utilize any desired combination of wired (e.g., cable and fiber) and/or wireless (e.g., cellular, wireless, satellite, microwave, and radio frequency) communication mediums and any desired network topology (or topologies when multiple mediums are utilized). Exemplary communication networks include wireless communication networks, public switched telephone networks (PSTN), and local area networks (LAN) or wide area networks (WAN) providing data communication services.

During operation, the first computing device 102A selects a portion of the data stored on the storage medium 110A for backup. In at least one embodiment, data is selected for backup based on characteristics of the data, such as the content or subject matter of the data, metadata associated with the backup or the like. The first computing device 102A then transmits the selected data to the second computing device 102B through the communication network 104. The second computing device 102B receives the data and stores the same on the second storage medium 110B.

Subsequently, the first computing device 102A or a replacement device thereof may request retrieval of the backup data from the second computing device 102B. The second computing device 102B retrieves the data from the second storage medium 110B and transmits the retrieved data to the first computing device 102A. The first computing device 102A receives the data and stores the same on the first storage medium 110A. Thus, the first computing device 102A may retrieve and restore backup copies of data stored on the second storage medium 110B and restore data lost because of data corruption, errors, a physical device failure or the like.

For example, a hard drive associated with the first computing device 102A may store various files of video content. Portions of the video files may be selected by the first computing device 102A and transmitted to the second computing device 102B for backup. Subsequently, the first storage medium 110A may fail and restoration of the files stored thereupon may be desired. The first computing device 102A (or a replacement thereof) may request retrieval of the files from the second computing device 102B via a message transmitted therebetween. The second computing device 102B retrieves the requested files from the second storage medium 110B and transmits the files to the first computing device 102A (or a replacement device thereof). The first computing device 102A then restores the received files onto the first storage medium 110A.

In at least one embodiment, a certain capacity of the second storage medium 110B may be available for storing backup copies of files from the first storage medium 110A. The allocated backup capacity of the second storage medium 110B may be significantly smaller than the total capacity of the first storage medium 110A and there may not be sufficient room to store backup copies of all of the files of the first storage medium 110A onto the second storage medium 110B. For example, 10% of the capacity of the second storage medium 110B may be dedicated to backing up content from the first computing device 102A. Thus, the first computing device 102A may prioritize the files to be backed up to efficiently utilize the backup capacity allocated on the second storage medium 110B.

Files may be selected for archival based on various attributes or characteristics of the files. For example, files that are frequently used/accessed by a user may be assigned a higher priority for backup than files which are infrequently used/accessed. In at least one embodiment, the subject matter/content of a file may be utilized to determine the priority for backup of the file. For example, files storing certain types of data or certain subjects of data may have a higher priority for backup than other files. In at least one embodiment, a user may assign a value to the priority for backing up particular files, either explicitly (e.g., providing input specifying the priority) or implicitly based on other actions taken by the user (e.g., locking the deletion of the files by others). It is to be appreciated that any combination of the aforementioned attributes or characteristics may be utilized to select files for archival depending on desired design criteria.

FIG. 2 illustrates an embodiment of a computing device 102A of FIG. 1. The computing device 102A includes a presentation device 204, an input device 206, a controller 208, an output interface 210, an input interface 212, a memory 214, a storage medium 110A and a network interface 216. The components of the computing device 102A may be communicatively coupled together by one or more data buses 220 or other type of data connection. The computing device 102A may include other elements, components or devices not illustrated for the sake of brevity.

The computing device 102A may include any type of computing device, such as a television receiver, personal computer, laptop, server, audio playback device or the like. The controller 208 is operable for controlling the operation of the computing device 102A. As used herein, controller 208 refers to a single processing device or a group of inter-operational processing devices. The operation of controller 208 may be controlled by instructions executable by controller 208. Some examples of instructions are software, program code, and firmware. Various embodiments of controller 208 include any sort of microcontroller or microprocessor executing any form of software code.

The controller 208 is communicatively coupled to the memory 214, which is operable to store data during operation of the controller 208. Such data may include software and firmware executed by the controller 208 as well as system and/or program data generated during the operation of the controller 208. Memory 214 may comprise any sort of digital memory (including any sort of read only memory (ROM), RAM, flash memory and/or the like) or any combination of the aforementioned.

The computing device 102A also includes a storage medium 110A, which is any kind of mass storage device operable to store files and other data associated with the computing device 102A. In at least one embodiment, the storage medium 110A comprises a magnetic disk drive that provides non-volatile data storage. In another embodiment,

the storage medium **110**A may comprise flash memory. It is to be appreciated that the storage medium **110**A may be embodied as any type of magnetic, optical or other type of storage device capable of storing data, instructions and/or the like.

In the embodiment shown in FIG. **2**, the computing device **102**A also includes an appropriate network interface **216**, which operates using any implementation of protocols or other features to support communication by the computing device **102**A on communication network **104**. In various embodiments, network interface **216** supports conventional LAN, WAN or other protocols (e.g., the TCP/IP or UDP/IP suite of protocols widely used on the Internet) to allow the computing device **102**A to communicate on communication network **104** as desired. Network interface **216** typically interfaces with communication network **104** using any sort of LAN adapter hardware or the like provided within computing device **102**A.

The computing device **102**A also includes an output interface **210** operable to interface with the presentation device **204**. More particularly, the output interface **210** is operable to output information for presentation by the presentation device **204**. The output interface **210** may be operable to output any type of presentation data to the presentation device **204**, including audio data, video data, audio/video (A/V) data, textual data, imagery or the like.

The presentation device **204** may comprise any type of device capable of presenting data received from the computing device **102**A. In at least one embodiment, the presentation device **204** comprises a monitor communicatively coupled to the output interface **210** via any type of appropriate wired or wireless connection. In another embodiment, the presentation device **204** comprises a television communicatively coupled to the output interface **210** via video or A/V cabling, such as component A/V cables, composite A/V cables, High-Definition Multimedia Interface (HDMI) cables, S-video cables, coaxial cables or a wireless connection, e.g., WiFi, Bluetooth and the like. In at least one embodiment, the presentation device **204** comprises an audio receiver and/or one or more speakers for outputting audio data, such as music.

It is to be appreciated that the computing device **102**A and the presentation device **204** may be separate components or may be integrated into a single device. For example, the computing device **102**A may comprise a set-top box (e.g., a cable television or satellite television receiver) and the presentation device **204** may comprise a television communicatively coupled to the set-top box. In another example, the computing device **102**A and the presentation device **204** may be embodied as a laptop with an integrated display screen or a television with an integrated cable receiver, satellite receiver and/or DVR.

The input interface **212** is operable to interface with one or more input devices **206**. The input device **206** may comprise any type of device for inputting data to the computing device **102**A. More particularly, data received from the input device **206** may be used to control the operation of the controller **208** and/or the output of data to the presentation device **204**. The input interface **212** and the input device **206** may be communicatively coupled using any type of wired or wireless connection, including USB, WiFi, infrared and the like. In some embodiments, the input interface **212** may comprise a wireless receiver for receiving any type of RF or IR communication from the input device **206**. Exemplary input devices **206** include keyboards, mice, buttons, joysticks, microphones, remote controls, touch pads and the like. In at least one embodiment, the computing device **102**A comprises a television receiver and the input device **206** comprises a television remote control communicatively coupled to the television receiver.

The input device **206** may be further operable to control the operation of the presentation device **204**. For example, the presentation device **204** may comprise a television that is remotely controlled by the input device **206** using IR or RF signals. In at least one embodiment, the input device **206** may be integrated with the presentation device **204**. For example, the input device **206** and the presentation device **204** may comprise a touch screen display. The input device **206** may also be integrated with the computing device **102**A. For example, the input device **206** may comprise buttons of the computing device **102**A, such as an integrated keyboard of a laptop or a front panel display with buttons of a television receiver or other type of entertainment device.

The storage medium **110**A may store data files having varying importance to a user. The preservation of some files in the case of storage errors or physical failure of the storage medium **110**A may be very important to a user, whereas the preservation of other files on the storage medium **110**A may be less critical.

In operation, the controller **208** identifies one or more files stored on the storage medium **110**A for selective archival/backup on the second computing device **102**B. The controller **208** initiates retrieval of the files from the storage medium **110**A and transmission of the files to the second computing device **102**B via the network interface **216**. In at least one embodiment, the backup process may be performed transparently to a user. The backup process may be performed at any time according to any type of schedule. For example, the backup process may be performed in the middle of the night when a user is not using the first or second computing devices **102**A and **102**B.

In at least one embodiment, the storage medium **110**A may subsequently fail or may otherwise experience data corruption affecting the storage of data thereupon. After repair of the storage medium **110**A, the controller **208** may initiate transmission of a request via the network interface **216** to the second computing device **102**B. The message may request retrieval of the backup files stored on the second storage medium **110**B. The second computing device **102**B transmits the files to the network interface **216** and the controller **208** coordinates restoration and storage of the files onto the first storage medium **110**A.

The computing device **102**A may also be configured to store backup data for the second computing device **102**B. For example, the network interface **216** may receive files from the second computing device **102**B and the controller **208** may coordinate storage of the files onto the first storage medium **110**A. In at least one embodiment, the storage of backup files onto the first storage medium **110**A may be performed transparently to a user of the first computing device **102**A. In other words, a user of the first computing device **102**A may not be aware of the storage of the files onto the storage medium **110**A. For example, the output interface **210** may output menus of files stored on the storage medium **110**A, and such menus may not illustrate to a user the existence of backup files stored on the storage medium **110**A.

In at least one embodiment, two similar computing devices **102**A and **102**B may each be configured to store a portion of backup data associated with the other device. Thus, a portion of the capacity of each computing device's **102**A-**102**B storage medium **110**A-**110**B may be allocated to storage of backup data for the other device depending on desired design criteria. For example, 20% of the storage capacity of each

storage medium **110**A-**110**B may be allocated to storing backup data for the other computing device **102**A-**102**B.

The techniques described herein are particularly applicable to selectively archiving multimedia content, such as photos, audio content, video content or audio/video content. For example, the techniques described herein may be utilized to selectively archive recorded television programs on a DVR. The embodiments described herein will be described in the context of a television distribution network and an associated DVR. However, it is to be appreciated that the techniques may also be applied to other types of multimedia systems, such as audio playback devices or video game consoles.

FIG. **3** illustrates an embodiment of a communication system **300**. The communication system **300** includes a content source **302**, a television distribution system **304**, DVRs **306**A and **306**B, presentation devices **308**A and **308**B and a communication network **310**. Each of these components is discussed in further detail below. The communication system **300** may include other components, elements or devices not illustrated for the sake of brevity.

The content source **302** is operable for receiving, generating and communicating content to one or more DVRs **306**A-**306**B. The content to be received, processed, outputted and/or communicated may come in any of various forms including, but not limited to, audio, video, data, information, or otherwise. In at least one embodiment, the content source **302** is operable for receiving various forms and types of content from other sources, aggregating the content and transmitting the content to the DVRs **306**A-**306**B through the television distribution system **304**. It is to be appreciated that the content source **302** may receive practically any form and/or type of information from one or more sources including streaming television programming, recorded audio or video, electronic programming guide data and the like.

The television distribution system **304** is operable to transmit content from the content source **302** to the DVRs **306**A-**306**B. The television distribution system **304** may comprise any type of wired (e.g., cable and fiber) and/or wireless (e.g., cellular, satellite, microwave, and other types of radio frequency) communication medium and any desired network topology (or topologies when multiple mediums are utilized). Exemplary television distribution systems **304** include terrestrial, cable, satellite and internet protocol television (IPTV) distribution systems. In at least one embodiment, the television distribution system **304** broadcasts or multicasts content to a plurality of DVRs **306**A-**306**B. The television distribution system **304** may also distribute content to a specific addressable DVR **306**A-**306**B, such as video-on-demand content and the like. In at least one embodiment, the content source **302** may be embodied as a transmission facility of the television distribution system **304**. Exemplary content sources **302** include over-the-air (OTA) terrestrial transmission facilities, cable television distribution head-ends, satellite television uplink centers, broadband or internet servers and the like. The television distribution system **304** may also distribute non-video content, such as electronic programming guide data and the like which is processed by a DVR **306**A-**306**B.

Each DVR **306**A-**306**B is operable to receive content from the television distribution system **304** and store the received content for subsequent presentation to a user. Each DVR **306**A-**306**B is further operable to output the received and/or stored content for presentation by the presentation device **308**A-**308**B. In at least one embodiment, the presentation devices **308**A-**308**B are display devices (e.g., televisions) configured to display content to a user. The DVRs **306**A-**306**B may receive an audio/video stream in any format (e.g., analog or digital format), and store and output the audio/video stream for presentation by the presentation device **308**. In at least one embodiment, the DVRs **306**A-**306**B may be integrated with a television receiver, such as a satellite, cable, over-the-air, broadband or other type of television receiver that receives and demodulates television signals that are outputted for display on a display device (e.g., a television). As used herein, a television receiver or DVR may also be referred to as a set-top box, which is a television receiver that is located externally with respect to a display device. The DVRs **306**A-**306**B may be further configured to output menus and other information that allow a user to control the output of audio/video content by the DVRs **306**A-**306**B, view electronic programming guides (EPGs), set recording timers and the like. In some embodiments, the DVRs **306**A-**306**B and the presentation devices **308**A-**308**B may be integrated as a device combining the functionality of a display device and television receiver/DVR or the like.

Responsive to particular recording timers or recording commands, each DVR **306**A-**306**B coordinates the reception of video signals associated with a television program through a television receiving resource (e.g., a television tuner) and storage of the video signal onto a storage medium (e.g., a hard drive or Flash memory). In at least one embodiment, each recorded television program may be stored in a separate file on a storage medium of the DVR **306**A-**306**B. A DVR **306**A-**306**B may include any number of television receiving resources utilized for receiving television programs. A DVR **306**A-**306**B minimally includes at least one television receiving resource to receive and record video signals associated with a television program. A DVR **306**A-**306**B may include multiple television receiving resources to record multiple television programs simultaneously. For example, a DVR **306**A-**306**B may include two or more tuners that allow recording and/or viewing of multiple programs though a DVR **306**A-**306**B simultaneously. In at least one embodiment, a DVR **306**A-**306**B may include multiple types of television receiving resources, such as an over-the-air (OTA) tuner and a satellite and/or cable television tuner that may be utilized to receive and/or record programs from multiple sources.

The DVRs **306**A and **306**B are communicatively coupled through a communication network **310** and exchange data therebetween. The communication network **310** may comprise any type of communication network and may be similar to the communication network **104** (see FIG. **1**). For example, the communication network **310** may comprise a LAN within a home coupling two or more DVRs **306**A-**306**B. In another embodiment, the communication network **310** may comprise the internet or other WAN communicatively coupling multiple DVRs **306**A-**306**B in disparate locations.

FIG. **4** illustrates an embodiment of a DVR **306**A of FIG. **3**. FIG. **4** will be discussed in reference to the communication system **300** illustrated in FIG. **3**. The DVR **306**A includes a communication interface **402**, a storage medium **404**, control logic **406**, an input interface **408** and a network interface **410**. Each of these components will be discussed in greater detail below. The DVR **306**A may include other elements, components or devices which are not illustrated for the sake of brevity.

The communication interface **402** is operable to receive content **412** from the television distribution system **304**. More particularly, in at least one embodiment, the communication interface **402** receives and tunes a television signal including television programming. The communication interface **402** may receive an over-the-air (OTA) broadcast, a direct broadcast satellite signal, a cable television signal or an IPTV signal

and tune the content **412** to extract the selected television programming. In at least one embodiment, the communication interface **402** may comprise multiple tuners, utilized by the DVR **306**A to output and/or record multiple television programs simultaneously.

The storage medium **404** is operable to persistently store video signals recorded by the DVR **306**A. The storage medium **404** may comprise any type of non-volatile memory appropriate for storing video signals or other content recorded by the DVR **306**A. Exemplary storage mediums **404** include hard drives (e.g., magnetic memory), flash memory, battery backed up memory and the like. In at least one embodiment, the storage medium **404** may be internally located within the DVR **306**A. In other embodiments, the storage medium **404** may be located external with respect to the DVR **306**A. The DVR **306**A may also utilize a combination of internal and external storage mediums **404** for storage of video signals.

The input interface **408** is operable to wirelessly receive data from a remote control (not shown in FIG. **4**). The input interface **408** may communicate with a remote control utilizing any type of IR or RF communication link. In at least one embodiment, the input interface **408** receives a key code from a remote control (not shown in the figures) and responsively provides the key code to the control logic **406** for processing. The data received from the remote control may be utilized by the control logic **406** to control the output of content by the control logic **406**.

The control logic **406** is operable to control the operation of the DVR **306**A. The control logic **406** may be a single processing device or a plurality of processing devices that cooperatively operate to control the operation of the DVR **306**A. The control logic **406** may include various components or modules for processing and outputting audio/video content. Exemplary components or modules for processing audio/video content include a demodulator, a decoder, a decompressor, a conditional access module and a transcoder module.

The control logic **406** coordinates storage of the content **412** onto the storage medium **404**. More particularly, in at least one embodiment, the control logic **406** operates responsive to recording timers configured on the DVR **306**A to command the communication interface **402** to receive content from a specified channel and coordinates storage of the content onto the storage medium **404**. The control logic **406** may also operate to store content received from the communication interface **402** responsive to user input requesting to record a presently viewed program (e.g., the user presses a record button).

In at least one embodiment, the control logic **406** is operable to generate an audio/video output **414** based on the content **412**, e.g., pass through the signal for display by an associated presentation device **308**A. The control logic **406** is also operable to retrieve stored video content from the storage medium **404** to generate an audio/video output **414** for display by the presentation device **308**A. The presentation device **308**A then presents the audio/video output **414** to the user. The control logic **406** may incorporate circuitry to output the audio/video streams in any format recognizable by the presentation device **308**A, including composite video, component video, Digital Visual Interface (DVI), High-Definition Multimedia Interface (HDMI), 1394 and WiFi The control logic **406** may also incorporate circuitry to support multiple types of these or other audio/video formats. In at least one embodiment, as described above, the DVR **306**A may be integrated with the presentation device **308**A, and the control logic **406** may be operable to control the presentation of the audio/video output **414** by the presentation device **308**A.

To coordinate the storage of the content **412**, the control logic **406** is operable to receive user input requesting to record one or more television programs. The control logic **406** responsively sets recording timers associated with the television programs. Responsive to the recording timers, the control logic **406** coordinates the recording of the content **412** into a file of the storage medium **404**.

The network interface **410** is connected to a communication network **310** (see FIG. **3**) and provides bi-directional data transmission between the DVR **306**A and the DVR **306**B and/or other devices on the communication network **310**. In at least one embodiment, the network interface **410** is an Ethernet connection communicatively coupled to the internet or other type of data communication network. It is to be appreciated that other types of wired and wireless connections may be utilized, such as WiFi, depending on desired design criteria.

In at least one embodiment, the control logic **406** identifies various files **420** for transmission to the DVR **306**B and the network interface **410** initiates transmission of the files **420** to the DVR **306**B through the communication network **310**. The DVR **306**B receives and stores the files **420** for backup purposes. The control logic **406** may then subsequently request retrieval of the files **420** from the DVR **306**B and utilize the received files **420** to restore data stored on the storage medium **404**.

Similarly, the network interface **410** may receive different files **420** from the DVR **306**B and provide the files **420** to the control logic **406** for further processing. For example, the DVR **306**B may provide files **420** to the DVR **306**A for backup storage on the storage medium **404**. The control logic **406** coordinates storage of the files **420** onto the storage medium **404** for backup purposes. Responsive to a subsequent request, the control logic **406** is operable to initiate retrieval of the backup copies of the files **420** on the storage medium **404** and transmission of the files **420** through the network interface **410** to the DVR **306**B.

As described above, data may be selected for backup based on various characteristics or attributes of the files. In at least one embodiment, data is assigned a value based on various criteria and high valued content is prioritized for backup on another computing device. For example, various heuristic rules may be applied to identify high value content. The DVR **306**A may then select portions of data stored on a storage medium based on the values and transmit the selected portions of data to another computing device for backup storage.

For example, a user may provide input specifying the importance of the file (e.g., high, medium or low importance), either when setting a recording timer or subsequent to recording of the event. In at least one embodiment, a user may lock a file from deletion. The locking of the file may be utilized by the control logic **406** to implicitly specify the importance of the file. The importance of the file may then be utilized to prioritize files for backup on another computing device. In at least one embodiment, a content provider may provide metadata, in association with video content, specifying the importance of an event. For example, a big sporting event, such as the Super Bowl, may be designated as a high importance event, whereas a particular episode of a news program, such as Sports Center may be designated as a low importance event.

In at least one embodiment, the content or subject matter of an event may be utilized to prioritize backup of particular content. For example, specific programs of content may be assigned a high value, such as top rated programs, programs frequently viewed by the user, programs which the user typically watches related programming (e.g., same series or simi-

lar genre) or the like. In at least one embodiment, programs broadcast on a specific channel may be assigned a high value based on the broadcast network.

In at least one embodiment, one-off or special edition programming may be identified as a high value event. For example, a special news program about the death of a celebrity may be identified as a high value event. A one-time purchase event may also be tagged as high value content. In at least one embodiment, programming which is recorded responsive to a single instance recording timer rather than a recurring recording timer may be identified as a high value event. For example, a user that sets a recording timer to record a single episode of Seinfeld more likely places a high value on the recording than a user that has recorded every episode of Seinfeld using a recurring timer.

A user's viewing habits may also be utilized to identify high value content. For example, content which has been viewed repeatedly may be identified as high value content based on the frequency of viewing. In at least one embodiment, if a user frequently views a particular series of programming, then programming from that series may be designated as high value content. For example, if the user views every episode of a particular program, then one or more episodes of the program may be identified as high value content. In at least one embodiment, the control logic **406** may place particular emphasis on valuing unviewed content. For example, if a user watches every episode of a particular television series, then the control logic **406** may identify unviewed episodes of the series television series as high value content until the episode is viewed. In at least one embodiment, the genre of programming may also be utilized to identify the value of content for backup. For example, if a user predominantly watches honor programming, then the control logic **406** may value horror programming higher than other genres of programming, such as romantic comedies.

In at least one embodiment, the frequency of broadcast for particular programming may also be utilized to identify the value of the content. For example, programming which is frequently broadcasted may have less value to the user because the content is more easily replaceable. Thus, if the storage medium **404** fails, then the control logic **406** may be able replace frequently broadcasted content (e.g., syndicated programming, such as Sponge Bob Square pants) quickly by recording subsequent broadcasts of the programming. In at least one embodiment, the control logic **406** searches an electronic programming guide to identify future broadcasts of programming. If future broadcasts are located, then the control logic **406** may assign a lower-value to the content, depending on desired design criteria. For example, the control logic **406** may decide to allocate limited backup space to other programming which is not broadcast as frequently. In at least one embodiment, the control logic **406** may evaluate the value of content periodically as broadcast schedules change. For example, a frequently broadcasted program which is subsequently removed from the programming schedule may be reassigned a higher value once replacement of the program becomes more difficult.

It is to be appreciated that the control logic **406** may utilize any technique for selecting high value content for backup based on desired design criteria. Described herein are various embodiments of evaluating the value of content for backup purposes. The control logic **406** may utilize any combination of the aforementioned techniques for selecting content for backup depending on desired design criteria.

In at least one embodiment, content may be transmitted from the DVR **306**A to the DVR **306**B for backup in real-time. In other words, content is transmitted from the DVR **306**A to the DVR **306**B for backup as the content is being recorded. For example, the control logic **406** may operate to provide content **412** received by the communication interface **402** to the storage medium **404** for storage, the network interface **410** for transmission to the DVR **306**B and to the presentation device **308**A for output of the audio/video output **414** substantially simultaneously. Thus, content is backed up at an earlier time, lessening the likelihood of loss of the content if the DVR **306**A fails prior to operation of a subsequent archiving process.

While the techniques described herein are particularly applicable to backing up content on a set of paired DVRs **306**A-**306**B, it is to be appreciated that archival of content may be performed across a number of similar devices. For example, the DVR **306**A may transmit content for backup to multiple similar DVR devices communicatively coupled over a communication network. In at least one embodiment, data is duplicated across each of the other DVRs. For example, a single backup program may be stored on multiple other DVRs. In other embodiments, the DVR **306**A may identify a portion of content stored thereupon for backup on other devices and may divide the selected content for backup on other devices. In other words, the DVR **306**A stores a first portion of content on a first device, a second portion of content on a second device and a N-th portion of content on an N-th device.

In at least one embodiment, a communication network includes a plurality of DVR devices, each storing a distinct set of user accessible content. In the event of a storage failure, a DVR may be operable to retrieve content from various devices of the network to restore its data. Because many users record the same program, it may be possible for a DVR to restore its data in the event of a storage failure without having previously backed up content on other storage devices. Rather, the DVR may retrieve copies of the data from other storage devices of the network which are already storing the same data. This technique may be augmented with the selective archival techniques described above to backup less popular content on other devices of the network while leveraging highly available content stored on other devices to restore a storage medium in the event of a failure.

FIG. **5** illustrates an embodiment of a communication system **500**. The communication system **500** includes a plurality of DVRs **502**A-**502**F, a communication network **504** and a management server **506**. Each of these components is discussed in greater detail below. The communication system **500** may include other components, elements or devices not illustrated for the sake of brevity.

Each of the DVRs **502**A-**502**F is operable to receive and store content. Each DVR **502**A-**502**F may have the same recording capacity or a different recording capacity depending on desired design criteria. The DVRs **502**A-**502**F may be similar to the DVRs **306**A-**306**B (see FIGS. **3** and **4**) and further discussion in omitted herein for the sake of brevity.

The communication network **504** is operable to communicatively couple the DVRs **502**A-**502**F with each other and with other devices of the communication network **504**, such as the management server **506**. The communication network **504** may be similar to the communication networks **104** (see FIG. **1**) and **310** (see FIG. **3**) and further discussion is omitted herein for the sake of brevity.

The management server **506** is operable to manage the backup of content among the DVRs **502**A-**502**F. In at least one embodiment, the management server **506** maintains a profile of content stored on each of the DVRs **502**A-**502**F. The management server **506** may be further operable to request each of the DVRs **502**A-**502**F to backup content on another

DVR **502**A-**502**F, depending on various factors. In at least one embodiment, the management server **506** may be a separate physical device distinct from the DVRS **502**A-**502**F. In another embodiment, the functionality of the management server **506** may be performed by one or more of the DVRs **502**A-**502**F.

Table 1 illustrates an embodiment of the content stored on each of the DVRs **502**A-**502**F. As illustrated in Table 1, there are ten programs that are recorded on the various DVRs **502**A-**502**F. The management server **506** receives data from each of the DVRs **502**A-**502**F specifying the content stored thereupon, either in real-time or based upon a periodic schedule. Based upon the data in Table 1, the management server **506** determines whether a particular DVR should transfer content to another device for backup.

TABLE 1

Content stored on the DVRs

DVR	Program									
ID	1	2	3	4	5	6	7	8	9	10
A	X		X		X		X	X		X
B	X	X					X			
C		X		X		X	X	X	X	X
D	X	X	X		X	X	X		X	X
E	X	X			X	X				X
F	X							X		

As illustrated in Table 1, program 1 has been recorded by five of the six DVRs **502**A-**502**F. Thus, in at least one embodiment, the management server **506** may determine that none of the DVRs **502**A-**502**F should backup this particular program on another device due to the widespread availability of the program on the communication network **504**. Similarly, programs 2, 7 and 10 have been recorded by at least four of the six DVRs **502**A-**502**F, and programs 5, 6 and 8 have been recorded by at least three of the six DVRs **502**A-**502**F, so it may not be desirable to backup copies of these particular programs due to the widespread availability of the recordings.

By contrast, program 4 has been recorded by just one of the six DVRs **502**A-**502**F. Thus, it may be desirable to backup a copy of the program on at least one of the other DVRs **502**A-**502**F. In at least one embodiment, the management server **506** instructs the DVR **502**C to transfer program 4 to another DVR, such as DVR **502**F, which has the most free recording capacity. Depending on the recording capacity of the various DVRs **502**A-**502**F, it may be desirable to backup the program 4 on multiple other DVRs **502**A-**502**F to protect against the possibility of failure of multiple DVRs **502**A-**502**F.

Programs 3 and 9 have both been recorded by at least two of the six DVRs **502**A-**502**F, so the availability of these programs in the event of failure of the corresponding devices is not as widespread as the other programs. Thus, it may be desirable to backup these programs on at least one other DVR **502**A-**502**F. For example, the management server **506** may direct the DVR **502**A to transmit a copy of program 3 to the DVR **502**E for backup. In the event of a storage failure, either the DVR **502**A or the DVR **502**D may retrieve program 3 from the DVR **502**E.

In the event of a failure of any particular DVR **502**A-**502**F, the management server **506** has records of what programs were recorded thereupon. Thus, the management server **506** may control the restoration of the programs onto the storage medium by authorizing a DVR **502**A-**502**F to retrieve and store programming from other DVRs **502**A-**502**F. The management server **506** is operable to allow a particular DVR to restore programming previously stored thereupon while restricting the DVR from retrieving programming which was not previously stored thereupon. For example, in the event of a failure, the DVR **502**F may retrieve and store programs 1 and 8 from other DVRs **502**A-**502**F, but may not retrieve and store any of the other programs illustrated in Table 1. Thus, the backup techniques described herein allow restoration of content that a device previously stored, while restricting the device's ability to later retrieve content which was not previously present on the device prior to failure.

FIG. **6** illustrates a process of storing media content. The process of FIG. **6** is particularly applicable to selectively backing up stored multimedia content on other devices of a communication network. The process of FIG. **6** may include other operations not illustrated for the sake of brevity.

The process includes storing a plurality of media content files on a first storage medium of a first entertainment device (operation **602**). For example, content files may be stored responsive to recording timers for various television programs.

The process further includes selecting a portion of the media content files for backup based on characteristics of the media content files (operation **604**). More particularly, operation **604** may include identifying high value content for selective backup. High value content may be selected according to any of the selection techniques described above. The process further includes transmitting the portion of the media content files from the first entertainment device to a second entertainment device through a communication network (operation **606**) and storing the portion of the media content files on a second storage medium of the second entertainment device (operation **608**).

In the event of a storage device failure, the first entertainment device may request to retrieve content from the second entertainment device for restoration of the data. The process may further include transmitting a request to the second entertainment device to retrieve the portion of the media content files (operation **610**) and receiving the portion of the media content files from the second entertainment device (operation **612**). Responsive to receiving the content from the second entertainment device, the first entertainment device stores the portion of the media content files on the first storage medium (operation **614**).

Although specific embodiments were described herein, the scope of the invention is not limited to those specific embodiments. The scope of the invention is defined by the following claims and any equivalents therein.

We claim:

1. A method of backing up media content files stored on a digital video recorder (DVR), the method comprising:

storing a plurality of media content files on a first storage medium of the digital video recorder, wherein each of the media content files is associated with a television program recorded by the digital video recorder;

assigning an archival value to each of the media content files based on characteristics of the associated television program;

automatically selecting only a portion of the media content files to be backed up based upon the archival values of the media content files such that the media content files having the highest archival values are prioritized for backup

transmitting the selected portion of the media content files from the digital video recorder to another digital video recorder through a communication link for backup storage on a second storage medium of the other digital video recorder.

2. The method of claim 1, further comprising:
transmitting a request to the other digital video recorder to retrieve the portion of the media content files stored on the second storage medium;
receiving the portion of the media content files from the other digital video recorder; and
restoring the portion of the media content files on the first storage medium.

3. The method of claim 1, wherein the assigning comprises determining a frequency that the associated television program is broadcast, and assigning lower archival values to programs with higher broadcast frequencies.

4. The method of claim 1, wherein the archival value is higher for a program that is recorded as a single instance than for a program that is recorded with a recurring timer.

5. The method of claim 1, wherein the archival value is based at least in part on a frequency of viewing of the plurality of media content files.

6. The method of claim 1, wherein selecting a portion of the media content files further comprises selecting at least one unviewed media content file for backup.

7. The method of claim 1, wherein the assigning comprises:
searching an electronic programming guide to locate other occurrences of the television program associated with the at least one of the media content files; and
increasing the archival value for the media content file responsive to locating no other occurrences of the television program in the electronic programming guide.

8. The method of claim 1, wherein selecting the portion of the media content files further comprises: selecting at least one media content file that has been protected by a user of the entertainment device.

9. A digital video recorder comprising:
a communication interface operable to receive television programming from a television distribution network;
a network interface communicatively coupled to a communication network;
a storage medium operable to store a plurality of media content files associated with a plurality of television programs that have been recorded by the digital video recorder;
and a controller operable to:
assign an archival to each of the media content files based on characteristics of the associated television programs;
automatically select only a portion of the media content files for backup on another digital video recorder based on the archival values of the media content files such that the media content files having the highest values are prioritized for backup;
and initiate transmission of the portion of the media content files from the digital video recorder for backup storage on a second digital video recorder via the network interface.

10. The digital video recorder of claim 9, wherein:
the processor is further operable to initiate transmission of a message to the second digital video recorder through the network interface, the message requesting to retrieve the portion of the media content files from the second digital video recorder;
the network interface is operable to receive the portion of the media content files from the second digital video recorder; and
the processor is operable to coordinate restoration of the portion of the media content files received from the second digital video recorder on the storage medium.

11. The digital video recorder of claim 9, wherein the network interface is operable to receive a second portion of media content tiles from the second digital video recorder and the processor is operable to coordinate storage of the second portion of the media content files onto the storage medium.

12. The digital video recorder of claim 9, wherein the archival value is assigned based upon a frequency that the associated television program is broadcast, such that lower archival values are assigned to programs with higher broadcast frequencies.

13. The digital video recorder of claim 12, wherein the processor receives metadata, from a content provider, the metadata specifying the archival value of the at least one of the media content files.

14. The digital video recorder of claim 9, wherein the processor is operable to receive user input specifying the archival value for the at least one of the media content files.

15. The digital video recorder of claim 9, wherein the archival values are based on a frequency of viewing of the associated television programs.

16. The digital video recorder of claim 9, wherein the processor selects at least one of the media content files for backup that is unviewed by a user.

17. The digital video recorder of claim 9, wherein the processor is operable to search an electronic programming guide to locate other occurrences of a television program associated with the at least one of the media content files and to assign the archival value responsive to locating no other occurrences of the television program in the electronic programming guide.

* * * * *